DOI: https://doi.org/10.37547/supsci-ojte-03-04-01 Pages: 1-13

ORIENTAL JOURNAL OF TECHNOLOGY AND ENGINEERING 2022-6.122, 2023-7.396

ORIENTAL JOURNAL OF TECHNOLOGY AND ENGINEERING

journal homepage:
https://www.supportscience.uz/index.php/ojte

TOPOGEODETIC BASIS OF SURVEYING AND DATABASE CREATION IN CONSTRUCTION OF ALTERNATIVE ENERGY FACILITIES

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ABOUT ARTICLE

Key words: Alternative energy, camera work, Samarkand, Nurabad, Tashkent, Bostanliq, sun, speed, wind, atmosphere, satellite, GNSS, level, polygonometry, classification, GAT, ArcGIS, AutoCAD.

Received: 21.07.23
Accepted: 23.07.23
Published: 25.07.23

Abstract: In this article, topogeodetic support for the construction of alternative energy facilities, input of fund, scientific and internet materials into the ArcGIS program of GAT, placement of requirements given in ISO, IEC, GOST and instructions into the QGIS program, input of remotely sensed aerospace and drone data into the FOTOMOD program, placement of materials obtained from topogeodetic fieldwork into the appropriate database through AutoCAD and CREDO programs, the data obtained from them are submitted for control by the customer and state authorities, coding and decoding of the object of alternative energy resources (MER) through ArcGIS and AutoCAD at the stage of camera works, and the issues of creating continuous cartographic materials related to MER were analyzed using ArcGIS, MapInfo, FreeHand programs.

МУҚОБИЛ ЭНЕРГИЯ ОБЪЕКТЛАРИНИ ҚУРИШДА СЪЁМКА ҚИЛИШ ВА МАЪЛУМОТЛАР БАЗАСИНИ ЯРАТИШНИНГ ТОПОГЕОДЕЗИК АСОСИ

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МАҚОЛА ҲАҚИДА

Калит сўзлар: Муқобил энергия, камераль ишлар, Самарқанд, Нуробод, Тошкент, Бўстонлиқ, қуёш, тезлик, шамол, атмосфера, сунъий йўлдош, GNSS,

Аннотация: Мазкур мақолада Муқобил энергия объектларини қуришнинг топогеодезик таъминоти, ГАТнинг ArcGIS дастурига фонд, илмий ва интернет орқали

нивелир, полигонометрия, синфлаш, ГАТ, ArcGIS, AutoCAD.

олинган материаллар киритиш, QGIS дастурига эса ISO, IEC, GOST ва инструкцияларда берилган талаблар жойлаштириш, FOTOMOD дастурига масофадан туриб зондланган аэрокосмик ва дрон орқали олинган маълумотлар киритиш, топогеодезик дала ишларидан олинган материаллар AutoCAD ва CREDO дастурлари орқали тегишли базага жойлаштириш, улардан олинган маълумотлар буюртмачи ва давлат органлари томонидан назорат олиб бориш учун тавдим этиш, камераль ишлар босқичида ArcGIS ва AutoCAD орқали муқобил энергия ресруслари (МЭР) объектини кодлаш ва декодлаш, МЭРга доир серияли давомли картографик материалларни яратишда ArcGIS, MapInfo, FreeHand дастурларини қўлла масалалари таҳлил қилинган.

ТОПОГЕОДЕЗИЧЕСКИЕ ОСНОВЫ СЪЕМКИ И СОЗДАНИЯ БАЗ ДАННЫХ ПРИ СТРОИТЕЛЬСТВЕ ОБЪЕКТОВ АЛЬТЕРНАТИВНОЙ ЭНЕРГЕТИКИ

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О СТАТЬЕ

Ключевые слова: Альтернативная энергетика, операторская работа, Самарканд, Нурабад, Ташкент, Бостанлыг, солнце, скорость, ветер, атмосфера, спутник, ГНСС, уровень, полигонометрия, классификация, GAT, ArcGIS, AutoCAD.

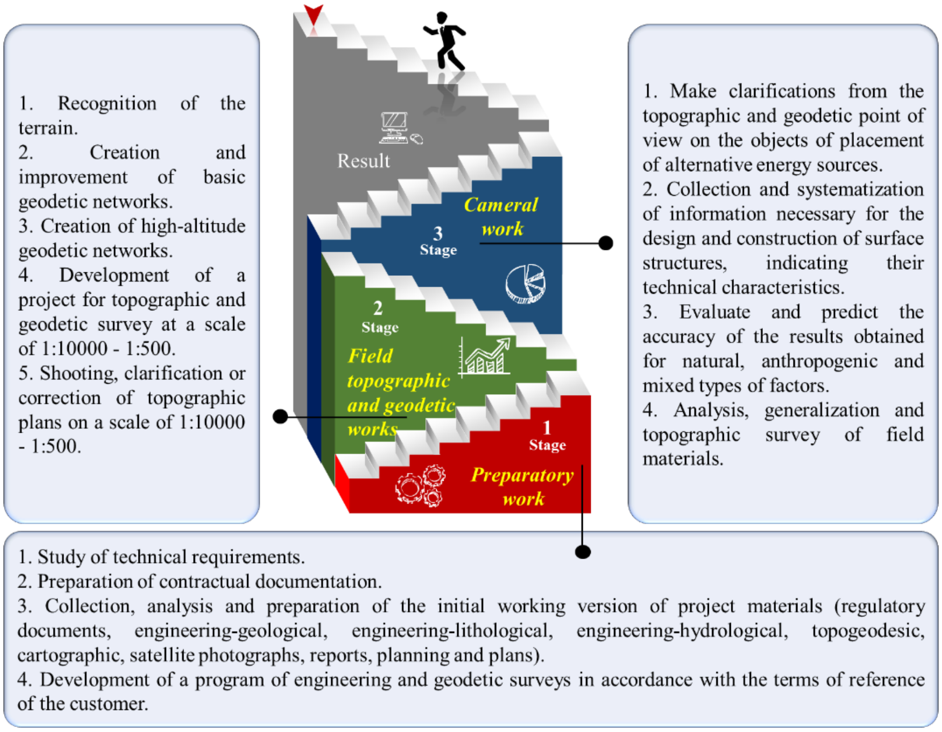
Аннотация: В статье рассмотрено топогеодезическое обеспечение строительства объектов альтернативной энергетики, ввод фондовых, научных и интернет-материалов в программу ArcGIS ГАТ, размещение требований, приведенных в ИСО, МЭК, ГОСТ и инструкциях, в программу QGIS, ввод аэрокосмических и беспилотных данных дистанционного зондирования в программу FOTOMOD, размещение материалов, полученных в результате топогеодезических полевых работ, в соответствующую базу данных через программы AutoCAD и CREDO, полученные из них данные передаются на контроль заказчику и государственным органам, кодирование и декодирование. кодирование объекта альтернативных энергетических ресурсов (МЭР) через ArcGIS и AutoCAD на этапе операторских работ, а вопросы создания сплошных картографических материалов, связанных с

МЭР, проанализированы с использованием программ ArcGIS, MapInfo, FreeHand.

INTRODUCTION

Topography, which is a branch of geodesy, is mainly engaged in the study of objects of use of alternative energy resources. Topography is a description of the Earth's surface on a local scale. His work of description from the geodetic point of view is considered a research object of “Topography” science.

At the design stage of the construction of alternative energy facilities, a number of works consisting of engineering-geological, engineering-hydrological, engineering-lithological studies are performed. The result of the design work is reflected in the topographic map, project, coordinate catalog, cross-sectional profiles. Topogeodetic research in the construction of alternative energy resources is carried out in three stages: preparation, field and camera work (Fig. 1).



***Picture 1.* Topogeodetic research stages of construction of alternative energy resources**

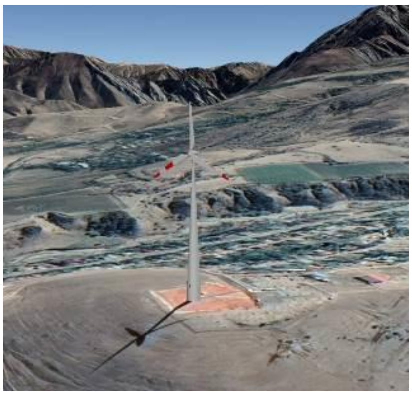
In the first stage of research - preparatory work, fund materials are collected and a program of engineering-geodetic research is developed according to the customer’s students.

THE MAIN RESULTS AND FINDINGS

The 2nd stage is the main stage of topogodetic research in the construction of alternative energy facilities. In this case, all research is carried out in the field, geodetic base networks are built, field surveys are carried out, topographic plans of the place on a scale of 1:10000 - 1:500 are updated and reconstructed.

At the stage of camera work, field materials are analyzed, summarized, topogeodetic plans are created, the accuracy of the results obtained in terms of natural, anthropogenic and mixed factors is evaluated, and a forecast for the construction of alternative energy facilities is made.

Topogeodetic research stages of the construction of alternative energy resources and the practical application of the design system.



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***Picture 2.* Selected research objects by altitude zones**

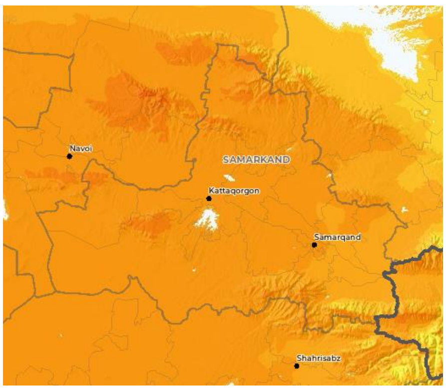
1− "Chotkal", Bustonliq district, Tashkent region.

2− "Sazogon", Nurabad district, Samarkand region.

Description of the object "Sazogon". Topogeodetic studies of the use of alternative energy resources were conducted at the facility located 5 km south of Sazoghon village, Nurabad district, Samarkand region. The geographical coordinates of the alternative energy facility are latitude 39.52^0, longitude 66.73^0. The absolute height is around 800 m. The area is located in the livestock zone, where light-colored barren gray soils are plowed.

The long-term average air temperature at the "Sazogon" facility is $+17.5^0$ C, and the normal direct solar radiation is 5.22 kW/m per hour^2.

The maximum daily radiation of the sun on the plane is 55.5% in the period of 13^{00}-15^{00}, and the heat level is 80-90%. The angle of incidence of sunlight corresponds to 89.2%, that is, the slope of installation of alternative energy resources. Exposure is 7^0, correct radiation is 69 percent (Fig. 3).

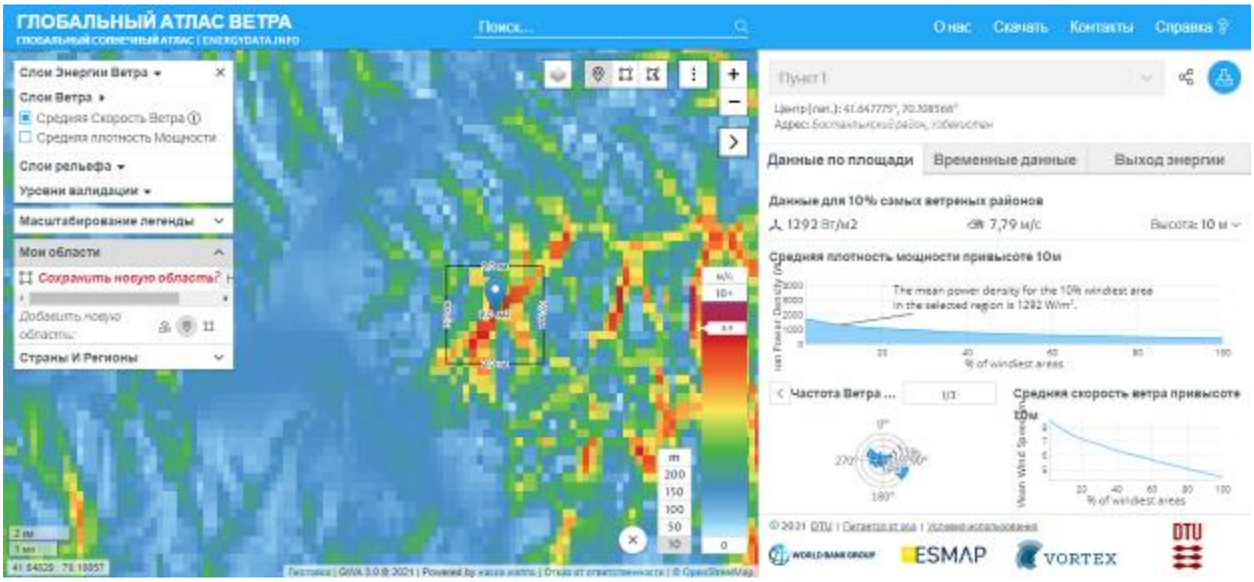


Picture 3. **Distribution card scheme of solar energy in Samarkand region**

Solar energy indicators in this area mentioned above can be the basis for the placement of objects.

Description of the object "Chotkal". Placement of alternative energy resources facilities on the use of wind energy was carried out in the "Chotqol" station, located in the territory of the Bostonliq district of the Tashkent region. Because in this object, the fyon wind blows constantly. In this area, carbonated alkaline brown soils are in the mountain pasture and horticulture zone.

At a height of 10 m above the ground, the wind speed is 8.5 m/s. The wind deflection is around 10-15 percent, and the voltage is 1292 V/m^2. In the morning, the Fyon wind blows from the Chotkal mountain towards the river valley, and in the evenings, the wind moves from the valley to the mountain. This constant blowing of daily and seasonal wind creates favorable conditions for the placement of alternative energy resources facilities (Figure 4).



Picture 4. **Indicators of wind energy in Bostonliq district**

Topogeodetic works were carried out taking into account the geographical diversity of the objects selected for the study.

The topogeodetic practice of designing alternative energy facilities is systematic, that is, it consists of a hierarchy of studies in a certain sequence. First, the lithological layer of the earth's surface is studied from an engineering point of view. It is carried out by studying the soil layer of the earth's surface, which has two parts - fertility. It is necessary to take into account the transplantation of the soil layer of the surface where the alternative energy facilities are located. This technological process is planned taking into account the technical aspects of collecting humus-rich (humus content 1–4% and above) soil layer and reclamation of the surrounding low-fertile land, and is placed on the topographic map of the design. For this, depending on the area

occupied by the alternative energy object, on a scale of 1:500–1:2000, prof. According to the methodology of V. M. Friedland, the map "Structure of the soil layer" is developed.

Research of power transmission line crossings is carried out in accordance with the rules for the placement of the unified power grid system introduced in Uzbekistan. Individuals and legal entities owning power grid facilities shall submit executive topogeodetic materials of routes to regional architecture and construction authorities for inclusion in the relevant land use maps.

Before the development of any type of topographic research (theodolite, tachometric, level, phototheodeolite, aerospace and ground-drone research), mandatory and extremely responsible work is carried out to create a geodetic (plan-elevation) basis. This determines the quality (accuracy) of topographic plans and ERM (digital terrain model). Objects of alternative energy resources are complex natural-technical linear objects, and geodetic provision of their planning is carried out through a system of points set on geodetic points with a certain plan or spatial (plan-elevation) coordinates for a certain period of time. (Instruction 2003, Turikeshev G.T. 2013). State geodetic (class 1–4) triangulation and height (class I–IV) leveling networks are used in the implementation of geodetic support for planning.

When determining construction sites and carrying out topographical surveying, the area is reconnoitered, complex field measurements and initial geodetic calculations are carried out, and a topographical plan of the area is created. Modern geodetic instruments such as GPS equipment, electronic tachyometer, theodolite, level and laser scanners are used for surveying alternative energy objects. It should be noted that even in field work, the requirements of the instruction on ensuring the level of accuracy are regularly fulfilled, the results of this survey are the main source for creating a topographical and general geographic database of the area.

Determining the ways of transmission of electrical networks. A project for the transmission of power lines will be developed on the basis of a topographical plan. Settlements and reclamation land areas, perennial orchards and vineyards, areas with high soil fertility and other equalized land areas, sanitary protection zones of recreation facilities, nature reserves, historical and cultural monuments, etc.

It is necessary to take into account the construction of power lines in the air-polluted areas, where there are polluting sources or where the construction is planned.

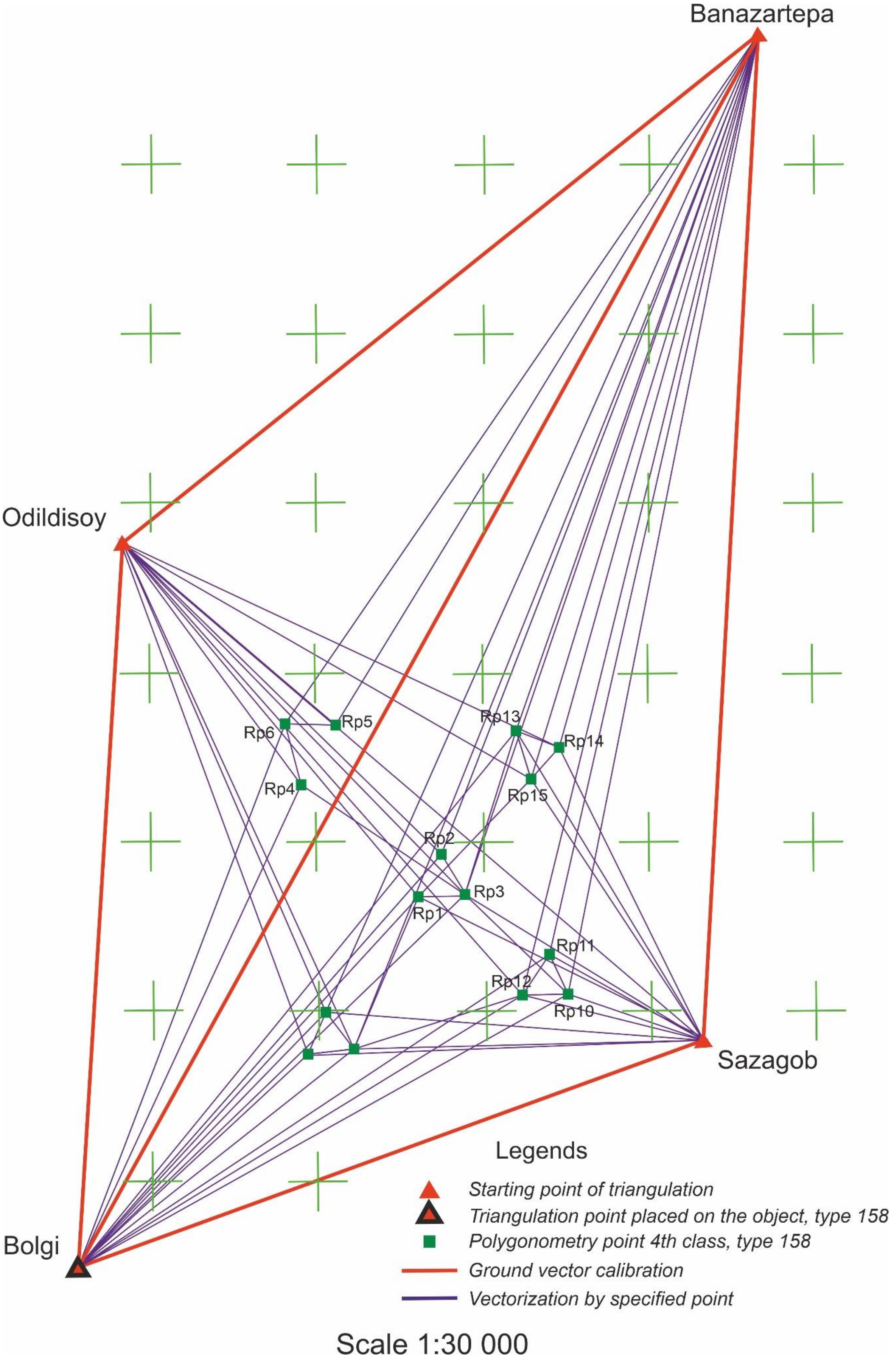
A laser level determines the relative height of points and transmits it from one point to another. Leveling is very useful in the process of surveying alternative energy objects, determining the shape of the terrain, describing and using them on the plan, and determining the optimal locations according to the types of alternative energy. In the field, a plan-elevation basis was created for topogeodetic surveying of the area in various methods and scales, using GPS devices and total stations.

The stage of field surveys consists of reconnaissance of the area, complex field work and preliminary calculation work, in which tasks such as creating large-scale geodetic reference networks and special planning points, creating a plan-elevation basis for topogeodetic planning, carrying out topographic surveying of the area and creating a topographic plan are performed.

Processing of field GNSS measurement results was performed in 2 stages: initial processing of satellite measurements, control of vectors and control between measurement sessions; Final processing of satellite measurements according to class 4 polygonometry path accuracy, i.e. equalization of measurement results.

The main task of the initial processing of satellite measurements is to obtain vector values and control their compliance with the specified requirement. The final alignment of the satellite network was carried out at the following starting points: Banazartepa (3 km), Odilsoy (3 km), Sazagon (2 km), and point 1 is located at this facility.

According to the results of on-site calibration, the maximum planned residual is 0.002 m, the residual in height is 0.003 m. The maximum relative error obtained in the network is 1:120,873 (with a fixed relative error of 1:25,000).



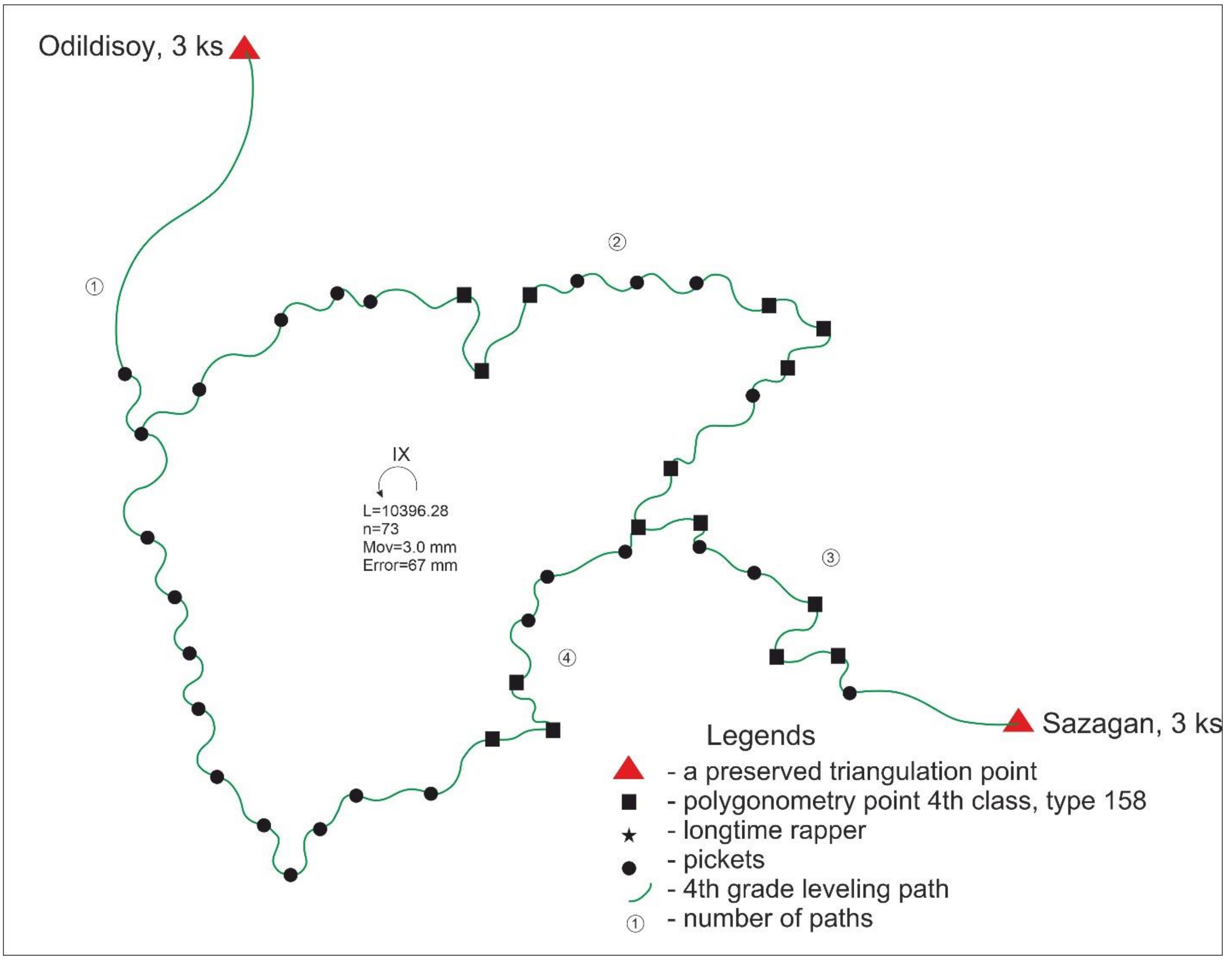
Picture 6. **4th grade polygonometry path drawing**

As a result of processing and equalization, a catalog of coordinates of geodetic network

points was created according to the accuracy of class 4 and class 1 polygonometry paths.

In accordance with the requirements of regulatory and technical acts (Alekseenko S.V. 2017) at the facility

Grade 4 leveling work was carried out. Class 4 leveling was carried out using digital leveling Trimble Dini 706013 - digital points (Fig. 6).



Picture 6. **Class 4 leveling network diagram**

Polygonometry path is the height of geodetic network points

Class 4 is determined by leveling. It is a two-node four-movement system (Rr-17, Rr-1). Based on the initial report, one landfill will be formed - Sazagon and Odilsoy.

The length of observation points is 100 meters - the unevenness of the base at the station is 2 meters, and their accumulation along the section did not exceed 5 meters; observation is carried out at a height of not less than 0.3 meters above the surface. Allowable *f=20 in leveling, mm; L - distance length* error is calculated by the formula.

The processing of field measurement results was carried out in accordance with the requirements (Karimov I.A. 2013). The equalization of the results of leveling of the 4th grade was carried out using the software complex “CREDO” module “CREDO DAT”. These are acceptable

indicators for calculating distance residuals, taken as input parameters: f=20 mm, $\sqrt{L}$L is the length of the distance.

The data collected as a result of research in the creation of topographic plans serve to create a database with the help of automated technologies. To them:

- ✓ obtaining coordinates of the research object, automatically collecting and processing field measurement data at observation points;
- ✓ including details based on topographical landmarks, importing terrain data into a personal computer through import software, creating a digital model of the site and using it as a digital topographical plan.

All technologies and their combination can be used to form a geoinformation base with general or basic data. For example, digitization of cartographic materials, automated field survey methods and remote sensing methods, etc. In addition, it is possible to use its models, other networks or scaled digital cartographic images in the formation of the geoinformation base.

The data scanning method is very effective in collecting or creating a database of geodata on alternative energy facilities. For example, initially collecting cartographic materials, taking photos and automatically recognizing geospace itself and alternative energy objects in a raster image, etc.

The most modern means of obtaining geospatial information are remote sensing and laser scanning. It provides three-dimensional models of the area that are the most natural. The three-dimensional geoinformation model creates many possibilities for cartographic representation.

The process of forming spatial objects is based on the principle of combining geometric, topological and attribute information. Currently, the most common is the mechanism of connecting geometric and attribute geospatial data collected separately in the spatial data bank of geoinformation. As a rule, it is a metric and attributive database that stores spatial information of territorial objects, consisting of two parts. The main principle of this mechanism is that the attribute is a type of data connection with the database.

At the stage of final ***camera works***, the code for objects is selected, thematic layers are installed and digitized using GAT technologies ArcGIS, AutoCAD programs. When creating a series of MER maps, general geographic maps with geodetic data are also collected and placed in ArcGIS, MapInfo, FreeHand programs. Alternative energy series cards are created based on topogeodetic plans.

State bodies and customers have the right to use the generalized database on the basis of an appropriate permit, and legal entities and individuals have the right to use it on the basis of payment.

In step 3, the topogeodetic database is not static, but dynamic. In order for it to be maximally adapted to the existing conditions, topogeodetic works are carried out at the relevant regular monitoring facilities at least once every 5 years. In case of force majeure, it is envisaged to carry out topogeodesic research even outside of the plan.

Creation and maintenance of any geoinformation base on alternative energy objects, regulatory and technical documents reflecting its information supply are reflected in the collection. In this case, it is necessary to use the information supply of coordinate systems and geodetic bases (plan-elevation grids) for all areas. It is also possible to develop information supply for other networks based on the topographical geoinformation base information supply model.

CONCLUSION

The legal-normative basis for the construction, surveying and creation of a database of alternative energy facilities begins with topogeodetic research. The options for the practical application of topogeodetic stages were selected in different altitude regions by analyzing alternative energy resources, and were carried out at the research facilities of "Chotqol" (wind MER) in Bostanliq district of Tashkent region, "Sazogon" (solar MER) of Nurabad district of Samarkand region. As a result, a system of topogeodetic practices in the hierarchy developed in the design of MER was developed.

2. Modern topogeodetic instruments were used in the surveying of alternative energy facilities. The field work carried out in accordance with the technical assignments at the MER facility consists of creating four types of geodetic surveys, IV level leveling at the points of the geodetic network according to the accuracy of class 4 polygonometry, carrying out 6 types of topogodesic work and preparing a technical report.

3. The database for design, construction and operation of alternative energy resources will be created in such a way that modern GAT programs are widely involved. The GAT database was formed through 5 interconnected and systematized components at the "Sazogon" MER facility. They consist of the creation of a 3-step topographic database.

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